

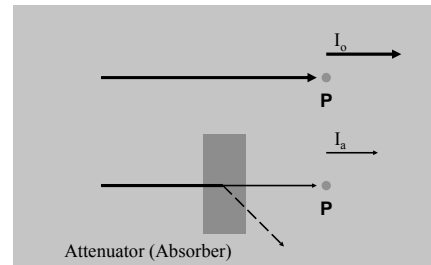
Attenuation of X Rays

Absorption of X Rays

1

Attenuation of X Rays

Definition of Attenuation



1

Attenuation of X Rays

Effect of Attenuator Thickness

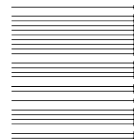
Equal thicknesses of a given attenuator remove equal fractions of the beams energy.

1

Attenuation of X Rays

Effect of Attenuator Thickness

24

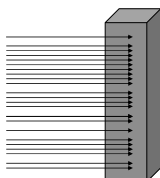


1

Attenuation of X Rays

Effect of Attenuator Thickness

24



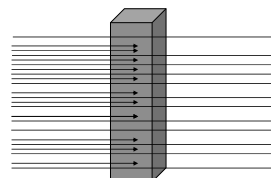
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Attenuation of X Rays

Effect of Attenuator Thickness

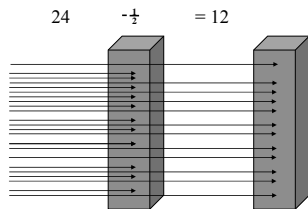
24

$-\frac{1}{2} = 12$



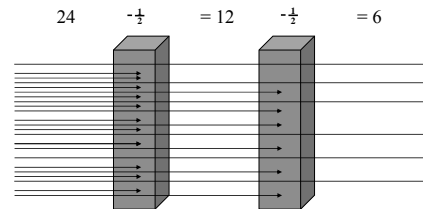
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Attenuation of X Rays Effect of Attenuator Thickness



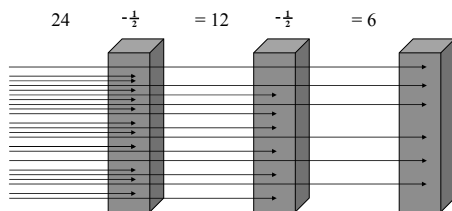
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Attenuation of X Rays Effect of Attenuator Thickness



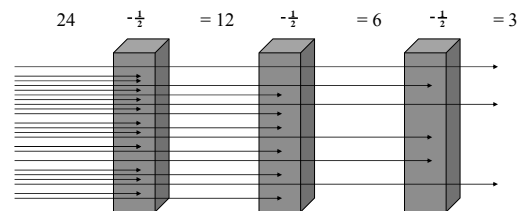
11

Attenuation of X Rays Effect of Attenuator Thickness



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Attenuation of X Rays Effect of Attenuator Thickness



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Attenuation of X Rays

Half Value Layer (HVL)

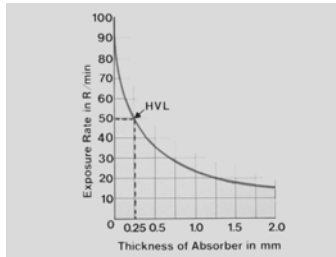
14

Attenuation of X Rays Half Value Layer (HVL)

The thicknesses of an attenuator that reduces the intensity of the beam to one half.

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Attenuation of X Rays Half Value Layer (HVL)



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Attenuation of X Rays Half Value Layer (HVL)

This is not a measurement of the attenuator, but of the mean energy level of the beam.

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Attenuation of X Rays

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Methods
of
Attenuation

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Attenuation of X Rays

1

Method
is
Geometry-based

15

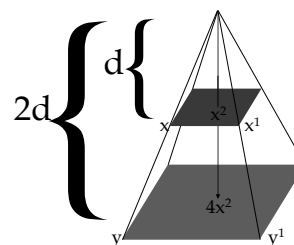
Attenuation of X Rays

Inverse
Square
Law

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Attenuation of X Rays

Inverse Square Law = Distance



If $x^1 = x$, then area is x^2 .
Since distance ratio is $2d/d$,
then $yy^1 = 2x \cdot x^1$, or $2x$.
Thus area at $2d$ is $(2x)^2$ or $4x^2$.

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Attenuation of X Rays

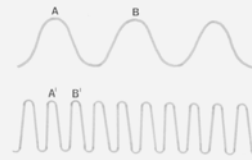
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Methods
are
Interactive

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Attenuation of X Rays

Different wavelength of photons

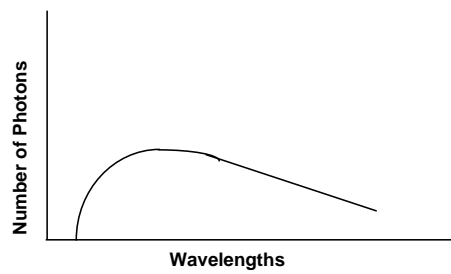


= different energies for interactions

20

Attenuation of X Rays

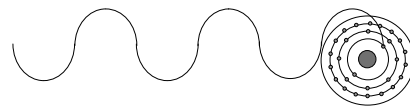
Spectrum of Wavelengths: Polychromatic



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Attenuation of X Rays

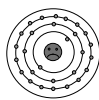
Coherent Scatter: Thomson Effect



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Attenuation of X Rays

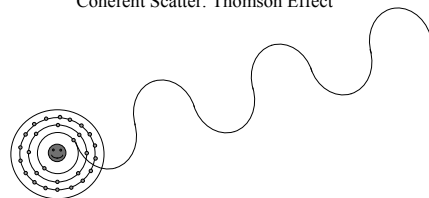
Coherent Scatter: Thomson Effect



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Attenuation of X Rays

Coherent Scatter: Thomson Effect



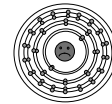
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Attenuation of X Rays
Coherent Scatter: Rayleigh Effect



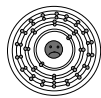
T0

Attenuation of X Rays
Coherent Scatter: Rayleigh Effect



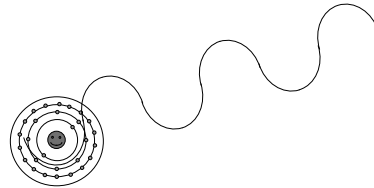
T1

Attenuation of X Rays
Coherent Scatter: Rayleigh Effect



T2

Attenuation of X Rays
Coherent Scatter: Rayleigh Effect



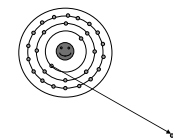
T3

Attenuation of X Rays
Photoelectric Effect



T4

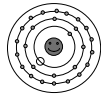
Attenuation of X Rays
Photoelectric Effect



T5

Attenuation of X Rays

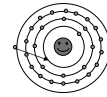
Photoelectric Effect



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Attenuation of X Rays

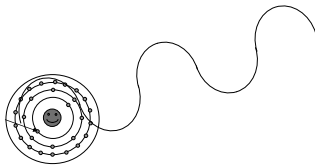
Photoelectric Effect



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Attenuation of X Rays

Photoelectric Effect



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Attenuation of X Rays

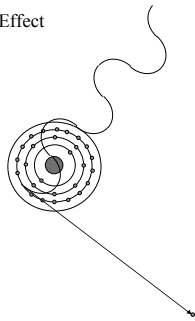
Incoherent Scatter: Compton Effect



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Attenuation of X Rays

Incoherent Scatter: Compton Effect

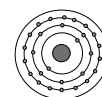


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Attenuation of X Rays

Pair Production and Annihilation Reaction

1.02 MeV



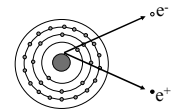
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Attenuation of X Rays Pair Production and Annihilation Reaction



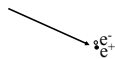
TV

Attenuation of X Rays Pair Production and Annihilation Reaction



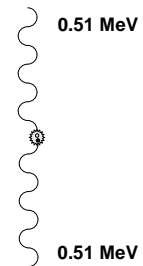
TA

Attenuation of X Rays Pair Production and Annihilation Reaction



TA

Attenuation of X Rays Pair Production and Annihilation Reaction



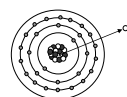
TA

Attenuation of X Rays Photonuclear Disintegration



TA

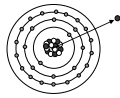
Attenuation of X Rays Photonuclear Disintegration



TA

Attenuation of X Rays

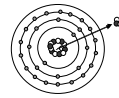
Photonuclear Disintegration



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Attenuation of X Rays

Photonuclear Disintegration



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Attenuation of X Rays

Secondary and Scattered Radiation Consists of

1. Secondary electrons
 - a. Photoelectrons
 - b. Compton or recoil electrons
 - c. Pair production electrons

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Attenuation of X Rays

Secondary and Scattered Radiation Consists of

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20

Attenuation of X Rays

Secondary and Scattered Radiation Consists of

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Attenuation of X Rays

Secondary and Scattered Radiation Consists of

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22

Attenuation of X Rays

Secondary and Scattered Radiation Consists of

1. Secondary electrons
 - a. Photoelectrons
 - b. Compton or recoil electrons
 - c. Pair production electrons

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Attenuation of X Rays

2. Secondary and scattered x rays
 - a. Coherent (unmodified) scattered
 - b. Characteristic
 - c. Compton (modified)
 - d. Annihilation
3. Nuclear particles
 - a. Protons
 - b. Neutrons
 - c. Alpha particles
 - d. Other particles

30

Attenuation of X Rays

2. Secondary and scattered x rays
 - a. Coherent (unmodified) scattered
 - b. Characteristic
 - c. Compton (modified)
 - d. Annihilation
3. Nuclear particles
 - a. Protons
 - b. Neutrons
 - c. Alpha particles
 - d. Other particles

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Attenuation of X Rays

2. Secondary and scattered x rays
 - a. Coherent (unmodified) scattered
 - b. Characteristic
 - c. Compton (modified)
 - d. Annihilation
3. Nuclear particles
 - a. Protons
 - b. Neutrons
 - c. Alpha particles
 - d. Other particles

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Attenuation of X Rays

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 - b. Characteristic
 - c. Compton (modified)
 - d. Annihilation
3. Nuclear particles
 - a. Protons
 - b. Neutrons
 - c. Alpha particles
 - d. Other particles

33

Attenuation of X Rays

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 - c. Compton (modified)
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 - b. Neutrons
 - c. Alpha particles
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Attenuation of X Rays

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Attenuation of X Rays

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